FABRICATION OF METAL OXIDE THIN FILMS AND THEIR CHARACTERISTICS STUDY

A Synopsis submitted to

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FOR

Registration of Ph.D. in PHYSICS

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Abstract:

The present proposed work deals with the fabrication of metal oxide thin films. As metal oxides plays vital roles in vast application domains.In recent years, nanostructured materials have attracted wide attention due to their fascinating optical and electrical properties, which make these materials potentially suitable for applications in electronics, optics, photonics, and sensors. Some metal oxides show a wide variety of morphologies such as nanowires, nanorods, nanotubes, nanorings, and nanobelts. Synthesis and investigation of these metal-oxide nanostructures are beneficial not only for understanding the fundamental phenomena in low dimensional systems, but also for developing new-generation nano devices with high performance. This proposed work will focus on synthesis, properties, characterizations, and numerical modeling of metal-oxide nanomaterials and nanostructures with potential applications.

1.Introduction

From last two decades, researchers are working on developing advanced materials for numerous applications. In this regards nanomaterials plays vital role for specific type of applications. People are working to know more about their characteristics too by means of different characterizations techniques too. Based on characteristics properties researcher utilizing these nanomaterials for specific purpose. In this regards, metal oxides have been proven to be potential candidates. The key properties possessed by metal oxides are, nano size, high surface to volume ratio, tenability with specific application, etc.

So here in this work, we are stressing to develop thin films of metal oxides and doped metal oxide thin films by various methods and its characteristics measurements.

2. Review of Literature and Development in the subject:

Summary of the most frequently used and some of the most promising methods to obtain precursor solutions of metal oxides

	Methods	**Chemical systems**	**Reference**
1	Sol–Gel	Alkoxide route; applied to transition and post-transition metal oxide films Solvents: alcohols (*e.g.*, methoxyethanol) Reagents: metal alkoxides	1,2
2	Chelate route	Modification of alkoxide route; applied to films of transition and post-transition metal oxides, and alkaline and alkaline earth oxides Solvents: alcohols and non-interacting liquids Reagents: metal alkoxides stabilized with polar groups, inorganic metal salts or metal carboxylates	3,4

3	Metal organic decomposition (MOD)	Applied to films of transition and post-transition metal oxides, and oxides of low valent ionic cations (*e.g.*, Pb^{2+}, Sr^{2+}, Ba^{2+}) Solvents: (short alkyl chain) water, polar solvents (long alkyl chain) non-polar solvents Reagents: metal carboxylates, metal alkoxides	5,6
4	Aqueous solution–gel	Applied to films of most metal oxides Solvents: water, chelating carboxylic acids, ethylenediamine, hydrogen peroxide Reagents: inorganic metal salts, water-soluble metal complexes	7,8
5	Molecular precursors	Applied to films of earth, transition, post-transition, lanthanide oxides Solvents: alcohols, diols, triols, alkanolamines, hydrofluoric acid Reagents: metal alkoxides, carboxylates, halides, alkyls or metal β-diketonates, zerovalent metals Applied to: metal oxides of alkaline, alkaline	9,10
6	Polymer assisted deposition (PAD)	Applied to films of alkaline earth and transition metal oxides Solvents: water with soluble polymers Reagents: nitrates of alkaline earth cations, hydrogen peroxide complexes of transition metals	11,12
7	Microemulsions	Applied to films of single metal oxides Solvent: water, oil, surfactant or block-polymer Reagents: metal alkoxides, metal carboxylates or inorganic metal salts	13,14

3.Objective of Research /Proposed Hypothesis:

This work will investigate properties of metal oxide thin films synthesized using different synthesizing technique. To achieve the above mention objective this work is made of specific aims

a. To synthesize metal oxide thin film and nanostructure on substrate various methods.

b. To characterize synthesized thin films and nanostructure using XRD, UV-Vis spectroscopy, Raman spectroscopy, TGA-DTA, SEM-EDS, etc.

c. To study the electrical conductivity and carrier mobility, transparent conductive properties of thin films and nanostructures using dedicated electrical characterization setup.

4. Methodology to be adopted:

Simple chemical approaches will be utilised for thin film preparations. The ease of methods like spray coating methods, spin coating methods, along with it chemical bath deposition as well as SILAR methods which are experimentally feasible will be used. After thin films preparation, various characterizations like XRD, FTIR, SEM/EDS etc. will be utilized for crystal and phase determination, functional group identifications and surface morphology/elemental study of the materials.

The prepared metal oxide thin films will undergo experimental conditions like I-V characteristics, optical characteristics as well effect of magnetic field study etc.

5. Importance of study / Society application:

- **International & National Statues**
  Various Indian groups have been demonstrated the successful synthesis of metal oxides thin films and its application in diverse field.Numbers of research groups across country are working on this important issue of thermoelectric materials and the outcomes addressing a variety of issues in this field have been supported by Government of India.[15,16,17]
- **Significance of the study**
  Various International groups have been demonstrated the successful synthesis of metal oxides thin films and its application in diverse field.In the specific research area to be focused upon in the proposed project, the international research is just beginning to grow creating a fairly open opportunity for Indian science to take a lead and make a substantial impact. [18,19,20].

6. Proposed work Plan/Formulation and Structure of Study:

	Work Plan	**First Year**			**Second Year**		
	Time Duration	**Months**			**Months**		
Sr. No.	**Experimental Methods**	**1-4**	**5-8**	**9-12**	**1-4**	**5-8**	**9-12**
1	Collection of chemicals	----------					
2	Synthesis of metal oxide thin films	----------	----------				
3	Characterization of synthesized metal oxide thin film by XRD, FTIR, TG/DTA, AFM techniques		----------	----------	----------	----------	
4	Synthesis of doped metal oxides		----------	----------			
5	Synthesis of Doped oxide thin films by changing experimental conditions		----------	----------	----------		
6	Characterization of thin films by using XRD, FTIR, AFM, TG/DTA, techniques		----------	----------	----------	----------	
7	Study of thin film characteristics		----------	----------	----------	----------	
8	Thin films applications		----------	----------	----------	----------	
9	Data collection and result analysis				----------	----------	----------
10	Report writing						----------

7.References

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Signature **Signature**

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